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Transportation Safety Training Center

Crash Investigation Team

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ABSTRACT

This special report entitled "Motorcycle Safety Helmet Effectiveness Study" examines selected crashes occurring in the Commonwealth as well as two cases that occurred in Pennsylvania. The purpose of the study is to compare unhelmeted riders involved in serious crashes with helmeted riders in similar crashes. Pennsylvania was chosen as a comparison state because legislators recently repealed its mandatory helmet use law for adult riders. Virginia too is considering the repeal of its mandatory helmet use law.

This report emphasizes the circumstances involved in five crashes, three fatal crashes in which a helmet was not worn and resulted in the deaths of the riders and two non-fatal crashes where the helmeted riders survived the collisions. Additionally, the Team reports on all 51 fatal motorcycle crashes occurring in the Commonwealth during the calendar year 2004 and notes the effects of the helmet use for these riders.

One main factor identified in this study is that riders who wear approved safety helmets decrease their chances of incurring serious or fatal head injuries during motorcycle crashes. Users of this Special Report are encouraged to support continuation of Virginia's mandatory helmet use law for highway safety purposes.

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INTRODUCTION

The single most effective safety practice associated with motorcycle crashes is the use of an approved, protective motorcycle helmet.

Why should motorcyclists wear helmets? Motorcycles are less stable and less visible than other larger motor vehicles. When they are involved in crashes, motorcycles are less "forgiving" than other motor vehicles and leave their riders more vulnerable to crash forces because their riders lack the protection of an enclosed surrounding. According to national studies, the motorcycle fatality rate is between 15 and 26 times higher than when riding in an automobile.

Department of Transportation (DOT) approved helmets, by design, are constructed with substantial, hard outer shells, thick protective/energy absorbing cushions with soft padded interior liners and strong retention straps and clasps. Therefore, they offer protection to the rider's head and brain. Riders wearing helmets have up to a 73% lower fatality rate and are 85% less likely to incur severe, serious or critical injuries compared to riders who are unhelmeted. Safety helmets that are properly fitted and worn correctly have been shown to be 67% more effective in preventing brain injuries, compared to crash injuries for unhelmeted riders. Inpatient costs and related hospitalization/medical expenses are significantly higher for unhelmeted riders because of such brain injuries. Often, the medical costs associated with these brain-injured victims far exceed the amount of insurance covering the motorcyclist. Thus, others in society end up paying for the remainder of these health care costs through tax-funded medical welfare programs and charitable contributions.

While public education and information certainly helps to encourage use, these approaches did not produce widespread or consistent helmet use. Beginning in 1967, and at the urging of the federal government, state legislatures began passing universal use laws in an effort to promote the use of safety helmets. These "universal" laws – laws which require all riders to wear helmets with no exceptions for age, driver experience or other exemptions – are the most effective in getting compliance for this critical safety practice. This is demonstrated by helmet

use of nearly 100% in states with laws covering all riders. As a result of such high use rates, serious injuries and fatalities have been reduced in those jurisdictions. Virginia enacted its motorcycle helmet use legislation in 1970 and it applies to all riders. Motorcyclists in the Commonwealth have consistently averaged about 99% helmet use rates in observation surveys.

In the early 1970's, virtually all states enacted laws requiring all motorcyclists to wear helmets. However, during the past 20 years, many state legislatures weakened or repealed these universal laws. As of July 2004, only 19 states and the District of Columbia have laws requiring all motorcycle riders to wear helmets. Twenty-seven states have modified laws requiring helmet use only by riders under a certain age (and/or other conditions) and four states have no laws regarding the use of motorcycle helmets. Pennsylvania was the most recent state to weaken its helmet use law; the change went into effect September 1, 2003.

According to the National Highway Traffic Safety Administration (NHTSA) in states where helmet use laws are weakened or repealed altogether, helmet use dropped to between 28-40%. In other words, the vast majority of motorcyclists, from 60 to 72%, *no longer wore protective helmets.*

Studies sponsored by the NHTSA compared the effects of the law changes on the helmet use rates and the subsequent increases in fatalities and injuries occurring in certain states. Two recent studies analyzed data from four states whose laws were weakened.

Arkansas and Texas repealed their universal helmet use laws in August and September 1997. Observed helmet use in Arkansas and Texas dropped from 97% to 52% and 66% respectively the first full year after the repeal. Helmet use among all injured motorcyclists involved in crashes in Texas dropped from over 90% before the law change in 1997 to 57% during 1998. In Arkansas, helmet use dropped from about 55% for those motorcyclists injured in traffic crashes before the law was repealed to about 32% the year after the law changed. In Arkansas, the number of motorcycle operators killed in traffic crashes increased during the first full year after the law's repeal by 21% (19 vs. 23) and in Texas by 31% (101 vs. 132). In Arkansas, emergency medical services data indicate that the number of motorcyclists suffering head injuries from traffic crashes increased about 78% (87 vs. 155) for the first full year after the law's repeal. Texas medical records indicate that the proportion of motorcyclists treated for

traumatic brain injury also increased following the law change. Treatment for other non-head injury cases did not change markedly.

Kentucky and Louisiana repealed their universal motorcycle helmet use laws in 1998 and 1999 respectively. Statewide observational surveys show that helmet use decreased following the repeal in both states from nearly full compliance to about 54% the next year. Motorcycle fatalities increased the year after the law changed by significant margins; over 50% in Kentucky and 100% in Louisiana. Injuries also increased substantially in both states. The increases reported in both fatalities and injuries were more than twice the national average increase over the same time periods. Injuries per registered motorcycles increased in Kentucky and Louisiana by 17% and 21% respectively following the law repeals while the national injury rate decreased by nearly 3%.

Virginia has lost 970 motorcyclists in traffic crashes over the past 20 years (1985-2004) for an average of nearly 49 deaths per year. If Virginia's General Assembly were to repeal the state's universal helmet use law, we could expect to experience a decrease in helmet use along with similar increases in fatalities and injuries realized in other states. Such an outcome would result in a profound, negative effect on motorcycle safety within the Commonwealth. The Crash Investigation Team estimates that during the first full year after the law is repealed helmet use rates will reduce to about 55% from its approximate 99% current rate. Consequently, this could translate into a 50% increase in motorcycle fatalities or about 25 more deaths each year.

In the best interest of highway safety, the Team strongly urges that Virginia retain its present universal helmet law. The purpose of this report is to emphasize through the interpretation of selected traffic crashes, the consequences of not being helmeted in a crash and the benefits wearing a motorcycle helmet.

CASE STUDY NUMBER 1

Type of Crash:	Rear end collision between two motorcycles
Day, Time, Season:	Sunday, 7:50 p.m., Fall
Vehicles Involved:	1982 Harley-Davidson, black cruiser type bike 1998 Harley-Davidson, red touring type bike
Roadway:	National Parkway
Occupants:	Lone driver on one motorcycle Driver and passenger on other motorcycle
Severity:	One fatality, one serious injury, one minor injury and moderate damage to the motorcycles.

SUMMARY:

On a clear, dry Sunday evening at about 7:50 p.m. in August, a group of eight motorcyclists on five motorcycles were traveling north on the Parkway. This mountainous, rural roadway is two lanes, asphalt paved, posted with a 45 mph speed limit, and marked with double yellow centerlines. The motorcyclists had spent the day together, celebrating the 29th birthday of one of the riders. After stopping off at a tavern restaurant on a roadway adjacent to the Parkway, the group entered the facility and headed toward their homes to conclude their pleasure ride. While at the tavern, they had reportedly eaten dinner and consumed alcohol while watching a NASCAR race. At a point 17 miles from where they had entered the Parkway, the two lead motorcyclists noticed several deer foraging on the side of the road. These motorcyclists slowed and signaled to the following riders to decelerate and be on the lookout for the deer. The third motorcyclist slowed down and stopped in the roadway behind the other two. However, the fourth motorcyclist in line saw the impending situation, but could not stop in time, and ultimately collided with the stopped third cycle. The fifth motorcycle also skidded on the straight downgrade but was able to stop safely without incident.

The third motorcycle was a black 1982 Harley Davidson, driven by its owner, a 48-year-old male who lives in the vicinity. He was riding alone and wore a non-DOT approved, but heavy, full head style helmet. After stopping, he heard the approaching motorcycle, looked

around to his rear, and saw it skidding toward him. The fourth motorcycle was a red 1998 Harley Davidson and was driven by its owner, a 31-year-old male. The driver was wearing a thin style, unapproved skull type helmet. Accompanying this rider was his 29-year-old wife, whose birthday the group was celebrating. She wore sunglasses and a bandana on her head to help keep her hair from being whipped into her eyes by the wind while she was riding. She was not wearing a helmet.

Photo No. 1: View looking north at the final rest of the crash involved motorcycles and the fatally injured female victim.

Due to driver error, the red motorcycle was unable to stop before reaching the black motorcycle. Its' driver applied the cycle's front and rear brakes causing the motorcycle's rear wheel to lock up and skid on the pavement. Physical evidence documented at the scene indicated that the cycle skidded in a relatively straight line for nearly 93 feet. At the north end of this skid mark, since the bike had not yet stopped, its front tire and wheel collided with the black motorcycle's rear wheel. This collision pushed the black motorcycle forward and across the centerlines, where it entered the southbound lane and went down on its side. The driver slid off

the black motorcycle and skidded to rest near the edge of the northbound lane. Shortly after colliding with the black motorcycle, the red motorcycle was knocked to the ground, where it began to slide and rotate on its left side along the northbound lane before the motorcycle was knocked to the ground. The female passenger, seated behind the driver, partially rode up his back and vaulted through the air over the driver's shoulder. She landed on the road some 76 feet beyond the point of impact. She then slid and tumbled along the northbound lane an additional 47 feet, coming to rest on her stomach on the eastern edge of the pavement. Her husband came to rest near the center of the roadway, south of her body. The red motorcycle came to rest in the northbound lane about 10 feet beyond the female victim.

Both the black and red motorcycle drivers came to rest with their helmets still on their heads. These non-DOT approved helmets displayed obvious exterior damage to their shells. The black motorcycle riders' helmet was a heavy, full head style, police-issue riot helmet intended to be worn by police officers during riots and demonstrations. Its full interior liner was heavily padded although not of the design and type of an approved motorcycle safety helmet. This helmet incurred heavy scrapes and scratches and part of the shell on its left side was shattered. The chinstrap and metal retention clasp were intact and did not fail during the collision. This rider received several minor abrasions and contusions to his arms and legs, but he incurred no head or face injuries in the collision. He was examined at the scene by rescue personnel and released.

The red motorcycle operator received only moderately severe body and extremity injuries in the collision. His most serious injury was a concussion and a broken nose. He was rendered unconscious at the scene and required medical air evacuation. He was flown to a major university hospital trauma center where he stayed for two nights. He is expected to fully recover with no head or brain debilitation. Although the helmet he wore was non-approved, it did offer a margin of protection. The helmet, which stayed on his head throughout the crash sequence, displayed heavy scuffs and scrapes on its left side, top and front, consistent with impacts with the asphalt surface. The interior was heavily stained with blood only in the helmet's left front and side, apparently from his broken nose. The thin, lightweight chinstrap and plastic retention clasp were unbroken and apparently held in place during the collision.

Photo No. 2: View of the two non-DOT approved helmets worn by the two motorcycle operators. Note the damages on each helmet.

The female victim was not as fortunate as her male counterparts. Because she traveled a greater distance after being ejected and because her path of travel along the asphalt surface consisted of both sliding and tumbling, she experienced greater impact forces. The helmet the female victim had with her at the time of the crash, but was not wearing, received no damage. The only blemish noted across its exterior shell was a very small paint transfer smudged on its top right side. The interior of the helmet and chinstrap/clasp were undamaged and there was no blood in her helmet. Because she was not wearing a safety helmet, she suffered a skull fracture and died almost instantly after the collision. She also received a broken neck; however, no chest, abdominal or pelvic trauma occurred. The medical examiner reported the cause of death as multiple skull fractures. The cervical fracture and exsanguination (heavy loss of blood) from the head injuries were noted as conditions contributing to her death.

After the crash, the uninvolved motorcyclists ran to the aid of the red motorcycle riders. They saw that the driver was injured but alive. They turned the female rider over onto her back

so they could better see her condition. Once turned, it was obvious that she had serious injuries. Her face was distorted and she was bleeding profusely. The motorcyclists called for help on their cell phones, which arrived within 20 minutes. Upon their arrival, it was determined that the female victim had expired. The investigating Park Ranger, with other Rangers assisting, completed his on-scene investigation that evening and returned to the scene the next day. While at the scene that night, he observed that the operator of the black motorcycle appeared to be alcohol impaired. A field sobriety test was given and the breath test indicated a reading of .13 BAC. A blood sample from the driver of the red motorcycle was seized at the hospital several hours after the crash and it indicated he also had a .13 BAC. The female victim had a .15 BAC. Criminal charges were later placed against both surviving drivers and the dispositions are pending at the time of this writing.

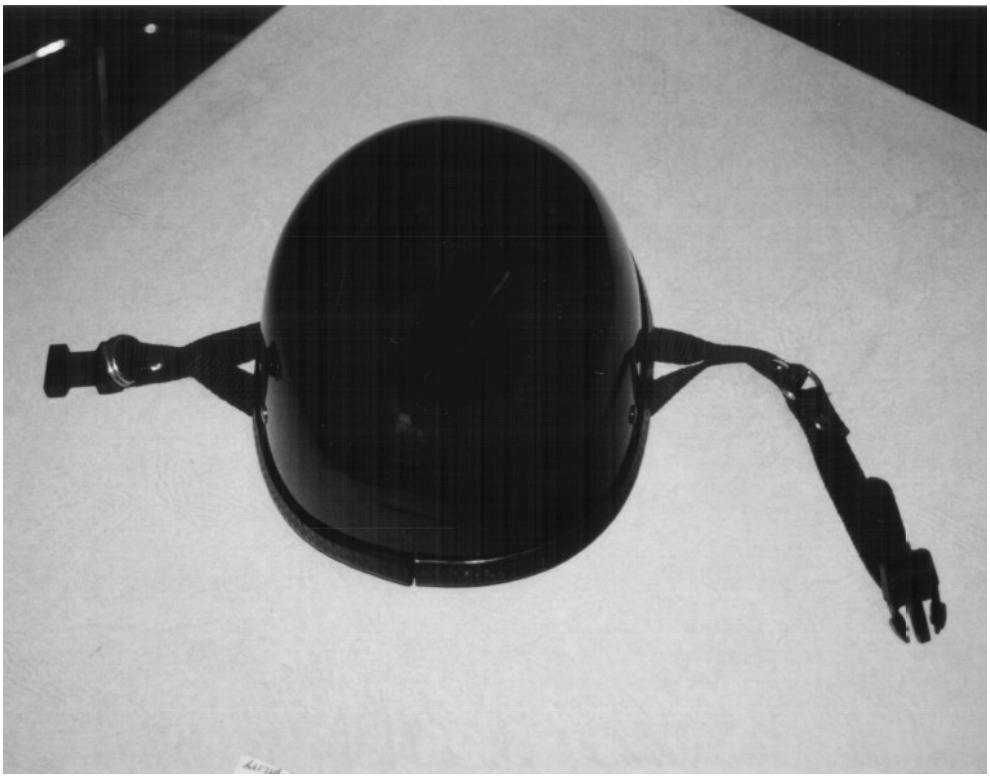

Photo No. 3: View of the non-DOT approved helmet (novelty type) owned, but not worn, by the fatally injured female victim. It is free of any damage.

DISCUSSION:

Physical evidence at the scene indicated that the red motorcycle skidded before impact and then slid on its side to a final rest. Using appropriate speed equations, the minimum original speed of the red motorcycle was calculated at about 44 mph. Using the appropriate modified throw equation for the total distance the female traveled, including the airborne distance and the slide/tumble distance, a likely speed for her at ejection was determined to be about 41 mph. The driver said that he was traveling about 45 mph when he saw the black motorcycle in front of him stop and then he braked.

This motorcycle crash illustrates the often-tragic consequences of riding unhelmeted. This crash was clearly survivable. The two riders who were helmeted survived the collision. Considering the dynamics, speeds and kinematics associated with the fatal victim, it is probable that, had she been properly wearing a DOT approved motorcycle safety helmet, she would have survived as well. Her chances of survival may have increased, although to a somewhat lesser extent had she been wearing her novelty helmet. Although speculative, it is possible that her alcohol intoxication (nearly twice the presumptive level) impaired her judgment and decision not to wear the helmet. Since she and her husband were experienced motorcycle riders, it is certain that they were aware that the helmets they purchased and wore were non-DOT approved ones. Whether they understood that novelty helmets offered significantly less protection than a DOT approved helmet is unknown. The Team feels that had her husband been properly wearing a DOT approved safety helmet, one with a full-face shield that offered more protection and padding, his head and face injuries would have been less serious.

CASE STUDY NUMBER 2

Type of Crash:	Angle collision
Day, Time, Season:	Friday, 3:49 p.m., Fall
Vehicles Involved:	2005 BMW RT1150, touring type bike 1992 GMC Sierra pickup truck 4X4
Roadway:	National Parkway, four leg/crossroad intersection
Occupants:	Two motorcycle riders wearing approved safety helmets Lone pickup driver
Severity:	Motorcycle driver incurred serious, multiple body and extremity injuries. Motorcycle passenger incurred minor extremity injuries.

SUMMARY:

On a clear, dry Friday afternoon, a new 2005 BMW motorcycle was southbound on a rural, two lane undivided highway. The motorcycle was being operated by its owner, a 44-year-old male, who was accompanied by his 39-year-old wife. The two motorcyclists were visiting the rural scenic area from their home in Georgia. They had visited a relative who lives several hours away and the three decided to drive along the Parkway. The relative was also driving his motorcycle but was positioned several hundred yards ahead of the couple. As the BMW was negotiating a long, flat curve approaching a crossroad intersection that is constructed on a skew, its driver noticed a westbound pickup approach the intersection. The intersection is controlled by stop signs facing the crossroads, with the parkway having the right-of-way. The pickup stopped and then began to pull out into the roadway, as the motorcycle got closer. Due to the acute angle of the intersection and the position of the motorcycle to the pickup driver's right and behind the passenger's doorpost ("B" pillar), the pickup driver apparently did not see the approaching motorcycle. Since the motorcycle was so close to the intersection when the pickup pulled out, its driver had insufficient time and distance in which to stop. By steering to the right and braking in an evasive action, he was able to slow the motorcycle down before impact, thus reducing the energy forces when the collision occurred. The motorcycle driver's wife, who had been looking

at the scenery and did not see the pickup truck and the impending collision, heard her husband scream, “Hold on!”

At a point near the center of the southbound lane, the pickup’s right front fender and wheel were impacted by the front wheel and fender of the motorcycle. The motorcycle and pickup immediately began to collapse as the two motorcycle riders were ejected from the bike and vaulted over the pickup’s hood. During the collision and due to the motorcycle’s momentum against the truck at impact, the pickup’s movement was shifted southward as it continued traveling west. The motorcycle rotated nearly 270 degrees clockwise against the truck as it was being slammed into the road surface. The truck’s right front tire/wheel assembly had fractured at the axle spindle and fell to the road surface as the pickup was coming to a stop in the eastbound lane of the crossroad. Both vehicles traveled nearly 30 feet beyond the collision point and came to rest beside each other, only a few feet apart. The motorcycle was lying on its left side, facing east.

The pickup driver told the investigating Park Ranger that he never saw the motorcycle until just at impact. He then saw the riders “fly over his hood” as the truck and motorcycle were coming to a stop. During the ejection sequence, both motorcycle riders were joined together by the wife’s arms clasped tightly around her husband’s waist. They completely cleared the pickup’s hood and fender and never contacted the truck’s windshield or roof. They continued across the eastbound lane and landed near the asphalt and grassy edge of the pavement, approximately 35 feet from impact. Evidence indicated that the two had skidded a short distance while on the asphalt surface.

Within moments after the crash, the pickup driver checked on the condition of the motorcycle riders and called for help via his cell phone. Other motorists stopped at the scene to assist. The uninvolved lead motorcyclist, after noticing that the other motorcycle was not behind him, turned around and drove back, where he discovered it had been involved in the crash.

Both involved motorcyclists were wearing protective clothing suitable for motorcycle riding, including approved motorcycle safety helmets. Both helmets remained on the riders’ heads at final rest and both displayed obvious damage from the collision. The driver received the most serious injuries, which necessitated him being air lifted to a hospital trauma center, located about 40 miles away. His wife sustained less severe injuries. She was also airlifted to the hospital

with her husband. The investigating Ranger completed his on-scene examination and the site was cleared about 1-1/2 hours after the crash occurred. He drove to the hospital to get a statement from the motorcycle victims and to check on their conditions. He had earlier received a statement from the pickup driver. The Ranger later charged the pickup driver with failure to yield the right of way.

Photo No. 4: View of final rest of the pickup and motorcycle. Note damage to pickup's right front fender and wheel areas. Both motorcycle riders vaulted over the pickup's hood after impact and came to rest on pavement beyond the pickup.

DISCUSSION:

Based on the physical evidence at the scene, the point of impact could be located by the presence of a tire and metal scuffmark located near the center of the intersection. This scuffmark was made by the motorcycle's front tire and wheel as they were collapsing on the roadway. Although the motorcycle was being braked by the driver's application of both front and rear brakes, as indicated by the sharp bend to the damaged front forks and the driver's statement, no pre-impact skid marks were evident on the pavement. The BMW was equipped with an antilock

braking system which prevents the wheels from locking up, thus also preventing skid marks. However, using various accident reconstruction equations, which consider the throw distance of the riders and the time-position of the pickup, calculations can be made to better understand the dynamics and forces associated with the collision. The motorcycle operator estimated that he was traveling about 45 mph prior to braking. The pickup at the point of impact was traveling about 14 mph, after pulling off from a stopped position. The likely speed of the motorcycle at impact, as calculated by the trajectory and airborne distance of its riders, was at least 25 mph. This indicates that the motorcycle had been decelerating at the point of impact even though no pre-collision skid marks were present on the pavement. This means that when the riders landed onto the hard asphalt surface, they were traveling in the mid-twenty mph range, clearly enough speed to cause serious or fatal injuries if they were not properly protected by the use of safety gear.

The helmets worn by both motorcycle riders were DOT approved. They were manufactured in Italy in March 2003 by Nolan and met the appropriate federal motor vehicle safety standards for motorcycle helmets. They were full-face designs with plastic face shields. Both identical helmets were large, heavy, had a thick padded inner liner and sturdy chinstraps and rivets. The label sewn inside the helmet said in part: *"No protective head-gear can protect the wearer against all foreseeable impacts. However, for maximum protection under this standard, the helmet must be of good fit and all retention straps must be securely fastened. The protective headgear is so constructed that the energy of a severe blow is absorbed through partial destruction of the headgear, though damage may not be visible to the naked eye. If it suffers such an impact, it should be either returned to the manufacturer for competent inspection or destroyed and replaced. Fasten helmet securely."*

The two helmets were examined by the Crash Investigation Team. The female's helmet displayed the most damage. The right side and center of the chin portion and face shield were badly scraped from contact with the asphalt. Additional road abrasions were noted on the top right half of the helmet. The chinstrap, buckle and full-face shield remained intact. No visible damages and/or blood, hair, or tissue were detected on the interior. The male's helmet displayed damage to the left side face shield connection point and scratches/smudges detected on its left lower chin portion, rear top and midsection and right topside midsection. The chinstrap and buckle assembly were intact and undamaged. No damage or blood/tissue was detected on the

interior, although it appeared somewhat worn. The condition of this helmet revealed that it was apparently used more than the wife's helmet.

The female rider remained hospitalized for two nights because of her injuries. She had a left wrist fracture and a possible fracture to her left hand. Her lower spine and ribs were badly bruised, and she received multiple scrapes and bruises throughout her body, including a deep abrasion to her left knee. Other than a minor bruise and contusion on her chin caused from contact with the helmet's interior chin guard, she sustained no head injuries. It is certain that had she not been fully protected by this safety helmet, she would have sustained significant injuries to her chin, face and probable life threatening injuries to her head.

The male motorcycle operator suffered serious abdominal injuries, requiring the removal of his spleen. He also received an "open book" fracture to his hips and pelvis, several broken ribs and his stomach muscles were torn away from his hip. He sustained numerous contusions and abrasions to his body; however, he received no face, head, or neck injuries. The driver remained hospitalized 15 nights due to his injuries. His physical rehabilitation will require months and it is unsure at this date if a full recovery is possible. Considering the dynamics and kinematics associated with this serious crash, he would have probably incurred life-threatening trauma to his head had he not been wearing his protective helmet.

This crash is an excellent example of the lifesaving and injury-reducing capabilities of properly wearing a DOT approved, full-face design, motorcycle safety helmet. This crash illustrates the three distinct rider impacts usually associated with a motorcycle-to-vehicle frontal collision crash. First is the collision between the rider and his motorcycle's handlebars and other components. A second common impact is contact with the striking vehicle and third, the abrupt impact with the road surface or ground. Any one of these three impacts can injure or kill a motorcyclist. To ensure the maximum protection for the motorcyclist, an approved motorcycle helmet must be properly fitted and worn at all times. This crash certainly illustrates a success story associated with helmet use.

Photo No. 5: View of both DOT approved helmets worn by both riders involved in the crash. The operators' helmet is on the left and his rider's helmet on the right. Both helmets incurred significant damage from striking the pavement after the collision.

CASE STUDY NUMBER 3

Type of Crash:	Angle collision
Day, Time, Season:	Saturday, 11:51 p.m., Summer
Vehicles Involved:	1995 Hyundai Sonata four door automobile 2001 Harley Davidson Dyna Glide motorcycle
Roadway:	Rural, two lane road
Occupants:	One motorcycle rider not wearing a helmet One motorcycle passenger helmeted One person in car
Severity:	One fatality (motorcycle operator) One injury (motorcycle passenger) and considerable property damage.

SUMMARY:

On a clear, dry Saturday night, a 1995 Hyundai Sonata was traveling north on a rural two-lane highway. This asphalt-paved road was in good condition and had a statutory 55 mph speed limit. Double yellow lines divided the two lanes. The vehicle was being operated by a lone, 20-year-old male. He had consumed alcoholic beverages prior to driving and consequently had a BAC of 0.09%. This driver entered a gentle curve to the right at a high rate of speed, failed to maintain his position in the northbound lane and crossed the double solid centerlines. He over-corrected, steering sharply to the right. Now heading off the road on the right, the driver over-steered again, this time to the left, while applying his brakes. The car slid from the northbound lane into the southbound lane and collided with an approaching motorcycle.

The motorcycle, a 2001 Harley Davidson, was operated by its owner, a 49-year-old male who was not wearing a helmet. The motorcycle had been traveling south in its assigned lane when the approaching car driver lost control. As it entered the southbound lane, the car began to rotate slightly in a counter-clockwise direction. Seeing the lights from the oncoming car in his path of travel, the motorcycle driver began braking and skidding. The motorcycle impacted the car's right front corner at the leading edge of the front tire. The motorcycle's un-helmeted operator was thrown from the bike into the windshield of the car. He remained on the windshield

until the car came to rest on the west berm of the road, falling from the vehicle into a field. The motorcycle passenger, a 38-year-old female who was wearing a DOT approved helmet, was thrown onto the roadway and came to rest near the motorcycle. Other motorists who came upon the scene called authorities. The Harley Davidson driver died at the scene from blunt force trauma to his head. His passenger suffered multiple body injuries that were non-fatal.

DISCUSSION:

Based on an examination of the Sonata, the investigating Trooper determined that the car had its lights on prior to the crash and that the front tires on the vehicle had a tread depth below legal requirements. Evidence at the scene combined with information about damage to the vehicles was used to calculate that this driver had been traveling between 50 and 60 mph. In comparison, the lighter motorcycle was calculated to have been traveling at 35 to 40 mph. The motorcycle operator only had a brief moment to begin braking before the collision. Thus, his estimated speed at impact was close to his traveling speed, between 30 and 35 mph. Although an examination of the motorcycle failed to reveal any defects, this vehicle did not display a required inspection sticker.

The cause of this crash is directly attributable to the driver of the car. He was operating a vehicle while impaired by alcohol and he was driving at excessive speeds. The high speed not only contributed to his loss of control, it also increased the severity of the impact forces, whereby increasing damage and injury levels. However, the severity of the consequences to the motorcycle riders was affected by their own decisions as well. The passenger's choice to wear a safety helmet provided her protection not afforded to the driver. Even though she impacted the roadway, she survived the crash. The driver suffered fatal head injuries that could have been reduced by the padding and hard outer shell of a helmet. This crash illustrates the continued need to approach highway safety improvement from multiple angles, including research on ways to reduce causal factors as well as ways to improve systems to forgive human error and reduce the severity of crash consequences.

CASE STUDY NUMBER 4

Type of Crash:	Single Motorcycle non-collision
Day, Time, Season:	Sunday, 6:50 p.m., Fall
Vehicle Involved:	2001 Suzuki GXR750 motorcycle.
Roadway:	National Parkway
Occupants:	One motorcycle operator wearing an approved helmet
Severity:	One moderate injury, considerable damage to motorcycle.

SUMMARY:

On a clear, dry Sunday evening in September, a group of motorcyclists had driven onto a rural scenic area of a National Parkway to engage in unlawful, drag racing and trick riding activities. The section of roadway, a spur off the parkway, was less traveled than the main line and was constructed with two parking overlooks within close proximity of each other. The roadway at this site is asphalt paved with two lanes, undivided, marked with double solid yellow centerlines. The roadway generally travels in an east-west direction. The western end is straight and level and as it travels eastward, the roadway gently begins a long curve to the right and a slight downgrade. Bordering the highway are grassy shoulders and guardrails. The pavement is in excellent condition and posted for 35 mph. Since the shoulders have no trees or brush, the sight distance within the vicinity is estimated at about 1200 feet.

A man and wife who came to enjoy the quiet, scenic conditions were at the parking overlook on the eastern section of the spur. They had been there for some time when the motorcycle group arrived. Since the couple was about 1000 feet away from the western overlook, the presence of the motorcyclists did not initially bother them. But, while they were there, they did see and hear several of the motorcyclists do “wheelies” and “race” together, both on the spur and in the overlook areas. As time passed, the motorcyclists began to travel east along the parkway and nearer the couple. Because of the loud noise from the motorcycles and the continued drag racing among some of the riders, the couple decided to get into their vehicle and leave. Within minutes of their decision, they noticed three of the motorcyclists positioned abreast

of each other and all facing eastward, toward them, about 800 feet away. One motorcycle was in the westbound lane, one in the center of the roadway and one in the eastbound lane. Simultaneously, when a signal was given by one of the uninvolved motorcyclists, the three accelerated rapidly toward the couple. For some reason, the Suzuki motorcycle in the westbound lane went out of control and went down onto the pavement. Its driver was thrown and then struck the pavement where he tumbled and slid to a stop, still in the westbound lane. These witnesses estimated that the motorcycle's speed was between "75-80 mph".

The driver of the Suzuki motorcycle was a 22-year-old male with several years driving experience on motorcycles. He owned the motorcycle, which was in excellent condition and was familiar with both the bike and the roadway. He was wearing a full-head style, DOT approved motorcycle safety helmet with a face shield. While traveling east in the westbound lane beside the other two motorcycles, the driver apparently sensed he was losing control of his motorcycle and decided to brake in an attempt to slow down. However, he braked too hard, causing the rear wheel to lock up and skid on the pavement. Physical evidence indicates that the Suzuki left a 52-foot long, straight skid mark diagonally across the westbound lane. The motorcycle then went down onto its right side, throwing it's' rider off, and the motorcycle slid and tumbled 192 feet across the pavement. It then slid nearly 100 feet, furrowing through the grassy shoulder until it returned to the pavement and slid an additional 28 feet on the asphalt before stopping. The motorcycle had traveled a total distance of 372 feet from the beginning of the skid mark to its final rest. After striking the pavement, the rider slid and tumbled in the roadway until he came to a rest about 100 feet west of the motorcycle. The two other racers were able to come to a controlled stop without mishap.

The motorcyclists ran to the aid of the downed rider and moved him to the grassy shoulder to await medical help. His helmet remained on his head during the entire crash sequence and was removed by the motorcyclist's friends. The couple who witnessed the crash immediately called 911 to request help. Then they also then went to the aid of the rider. Shortly after the crash and before emergency personnel arrived, several of the motorcyclists began to move the damaged motorcycle away from the scene. When the investigating Park Ranger arrived about 10 minutes later, the motorcycle was being lifted into the back of a truck, located about 50

feet from where it originally had come to a stop. Medical personnel were attending to the injured driver, who was conscious and talking.

The Ranger asked the injured motorcyclist what had happened and he said he was traveling about “40-45 mph when a large animal resembling a deer came out in front of him. He tried to stop, and he lost control”. The Ranger obtained statements from the other motorcyclists and they agreed with the injured rider’s version of what had happened and/or said they did not actually see the crash. The couple advised the Ranger that the motorcyclists were in the act of racing when the crash occurred. They also gave accounts as to what the group had been doing before the crash. The couple was at the scenic overlook watching for deer, since they are avid hunters. From the overlook, they directly observed the three motorcycles lined up beside each other just before the incident and they reported that at no time did they ever see a deer run out into the roadway.

Upon completion of the Ranger’s investigation, he charged the injured motorcyclist and one of the other motorcyclists, with reckless driving and giving false statements. The driver refused medical treatment at the scene. He left the site with a friend along with his motorcycle, which was in the bed of the pickup. The Ranger returned to the scene the next day to collect additional physical evidence. The Crash Investigation Team was contacted several months later to assist the Ranger and the US Attorney’s office in the reconstruction of this crash and to testify in Federal court.

DISCUSSION:

Based on the physical evidence, the minimum speed that the motorcycle was traveling just before the crash was calculated at 62 mph. This was determined by combining the tire skid mark with the total slide distance that the motorcycle traveled from the beginning of the skid mark to its final rest. Based on this evidence, it is clear that the speed the motorcyclist reported to the Ranger was inaccurate. While the speed estimated by the two independent eyewitnesses of "75-80 mph" might be excessive, their estimate appears more in line with the "minimum" speed (62 mph) calculated than with the driver's stated speed of "40-45mph". The investigating Ranger detected numerous tire skid and scuffmarks made by these motorcycles on the western parking overlook and on the spur. These fresh tire marks confirmed the witnesses' statement regarding the location of the racing and trick riding practices.

Friends took the injured driver to the hospital emergency room from his home several hours after the crash occurred. He sustained numerous abrasions and contusions over his entire body. He was examined and treated that night. However, he received no head, face or neck injuries in the crash. The helmet that the driver was wearing was inspected at the site by the investigating Ranger and it was reported to be a DOT approved safety helmet. The helmet had numerous scratches along its top and sides; however it was not broken or cracked. Its chinstrap and clasp were undamaged and intact. The helmet interior was unremarkable and displayed no damage, tissue or blood. Considering the motorcycle's high speed when the motorcyclist was thrown from the bike and made contact with the asphalt pavement, combined with his tumbling and sliding some 275 feet to a final rest, the fact that he did not incur any head injuries is a testament to the effectiveness of the helmet's safety benefits. It is probable that had the driver not been wearing the helmet, he would have sustained serious if not fatal injuries.

CASE STUDY NUMBER 5

Type of Crash:	Angle collision
Day, Time, Season:	Tuesday, 4:15 p.m., Fall
Vehicle Involved:	1994 Toyota extended cab pickup truck 2004 Harley Davidson Electra Glide Classic motorcycle
Roadway:	Rural, two lane road
Occupants:	One motorcyclist without a helmet Three restrained occupants in pickup
Severity:	One fatality (motorcyclist) Minor property damage to both vehicles

SUMMARY:

On a dry, overcast Tuesday evening a 2004 Harley Davidson motorcycle was traveling west on a rural primary road. A lone 57-year-old male operator, who was not wearing a helmet, rode the motorcycle. The driver stopped in his travel lane at the intersection of a secondary road, awaiting passage of oncoming traffic in order to make a left turn. His motorcycle's left turn signal light was activated. This area features some homes, a small business and is near a high school. The two-lane road has numerous curves and hills, including a curve that the motorcycle had negotiated prior to stopping. The sight distance from the curve to the intersection is 425 feet and a concrete bridge lies just beyond. The road has a posted 40 mph speed limit. The motorcycle operator began to execute his turn when he was struck on the left rear side by a Toyota pickup also traveling west.

The 1994 Toyota pickup was traveling slightly above the posted speed limit, in the same direction as the motorcycle. The driver, a 35-year-old female was accompanied by two children. She wore her lap and shoulder belt. A seven-year-old girl wearing a lap and shoulder belt sat in the rear seat while her 11-year-old sister sat in the right rear seat, restrained by her lap and shoulder belt. The Toyota negotiated the curve and approached the motorcycle from the rear as it began to execute its' turn. The driver of the pickup failed to perceive that the motorcycle was stopped and beginning to make a left turn. When she realized that she was overtaking the

motorcycle, the pickup driver swerved left in an attempt to avoid it. However, her action guided her vehicle directly into the path of the turning motorcycle, striking its' left side at the hard bag and fuel tank with the pickup's right front corner bumper. Upon impact, the motorcycle fell to the ground and slid several feet before stopping. The collision forces vaulted the motorcycle operator approximately 28 feet and he landed on the asphalt roadway on his back, striking the back of his head on the pavement. After impact, the pickup driver continued a short distance and then began braking. She also steered back to the right, finally coming to a stop on a bridge. Another motorist traveling in the opposite direction witnessed the events and summoned help.

None of the occupants of the pickup were injured and the vehicle sustained only minor damage to the right corner of the front bumper. The motorcyclist, however, sustained fatal head injuries, including numerous skull fractures, blunt force trauma to his chest, along with multiple fractures. The motorcycle sustained only light to moderate damage from impact.

DISCUSSION:

Skid marks at the scene indicate that the Toyota driver did not apply her brakes until after she collided with the motorcycle. These marks, combined with other physical evidence, were used to calculate speeds. The impact speed of the pickup was determined to be approximately 46 mph while the motorcycle speed was estimated at approximately 19 mph.

Driver error on the part of the Toyota operator was the cause of this crash, but the motorcycle driver's decision to ride without a helmet contributed to the severity of the outcome. Although he suffered other injuries, this driver died as a result of the skull fractures received when he landed on the roadway. This crash was probably a survivable had the motorcyclist worn a safety helmet designed to shield and cushion his head from impact forces.

TABLE INFORMATION

In an attempt to look more closely into the circumstances involving all reported motorcycle fatalities occurring during 2004, the Crash Investigation Team distributed questionnaires to each Virginia law enforcement officer who investigated a motorcycle death in the Commonwealth. These fatal crashes were identified from the State Police Daily Activity Reports. As of this writing, 51 questionnaires were faxed out and 44 responses have been returned. The Medical Examiners District offices were then contacted for injury and cause of death information in each fatality.

The helmet status of fatal victims was analyzed against cause of death as listed on the Medical Examiner's Report. This cross comparison is summarized in Table 1.

TABLE 1

Cause of Death

Helmet Status	Head Injury	Neck or Body Injury	Incomplete Data	Total Victims
Approved	15 (45.4%)	24 (72.7%)	2 (6.1%)	33
Novelty/Unapproved	5 (83.3%)	2 (33.3%)	0	6
No Helmet	4 (100%)	3 (75%)	0	4
Unknown	6 (75%)	2 (25%)	1 (12.5%)	8
Totals	30 (58.8%)	31 (60.8%)	3 (5.9%)	51

Note: the figures across will add up to more than 100% because some victims suffered both head and body injuries severe enough to be deemed fatal.

Thirty-three (64.7%) of the fatal victims wore DOT approved motorcycle helmets. Fifteen (45.4%) of these individuals died from head injuries while 24 (72.7%) died from neck or bodily injuries. (Eight of these victims suffered both head and body injuries.) For two (6%), the cause of death was not identified.

Six (11.8%) of the fatal victims wore unapproved, novelty helmets which provide less protection to the head. Five of the 6 (83.3%) died of head injuries, while only two (33.3%) received neck or body trauma. (One of these individuals suffered both head and body injury.)

Four fatalities (7.8%) involved motorcyclists who wore no helmet. All four (100%) suffered fatal head trauma. Additionally, three (75%) of the four also had neck or body injury, which contributed to their deaths.

Of the eight fatalities (15.7%) where helmet use was unknown or not listed on the report, six (75%) suffered lethal head injuries. Only two (25%) died from neck or body injury, one of whom was included among the head injury fatalities. The cause of death is not known for the other.

This analysis clearly shows the relationship between fatal head injury rates and the level of head protection worn by these motorcyclists. The less protection a victim wore, the greater the likelihood that their fatal injury would involve the head. All unhelmeted victims suffered fatal head trauma. While helmeted drivers may still suffer lethal head injury in a crash, the risk is reduced, as evidenced by the lower percentage rates.

Table 2 lists all the reported motorcycle fatalities and their circumstances/questionnaire results occurring in Virginia during 2004 (as of this writing). Table 3 notes the past 20 years of motorcycle deaths reported in the Commonwealth. Table 4 is a summation of the most recent four states that repealed their helmet use laws as studied by the National Highway Traffic Safety Administration.

TABLE 2
Virginia Motorcycle Traffic Fatalities - 2004 (51 total)

	Date/Time	Crash Location	Position/Age/Sex	Cause of death	Helmet Use/Comments	Crash Circumstances/At Fault Driver
1	1/3/2004, 1530 hrs	Bedford County, Secondary Highway	Driver/64/M	Head trauma	Legal/Came off at impact	**M/C** ran off road and struck tree; Fail to maintain control - motorcycle operator
2	1/18/2004, 1146 hrs	Hanover County, Primary Highway	Driver/21/M	Fracture to cervical spine	Legal	**M/C** struck mailbox and culvert; Reckless driving and alcohol use - motorcycle operator
3	2/9/2004, 0105 hrs	Campbell County, Secondary Highway	Passenger/22/M	Chest/lung injuries	Legal	**M/C** ran off road and struck embankment; Reckless driving and alcohol use - motorcycle operator
4	2/28/2004, 0255 hrs	Henrico County, Urban Street	Driver/33/M	BFT to head- closed	Novelty	**M/C** struck ditch and pipe; Reckless driving and alcohol use - motorcycle operator
5	2/28/2004, 1520 hrs	Grayson County, Primary Highway	Driver/42/M	Massive closed head injury	Legal	**M/C** ran off road and struck embankment; Reckless driving - motorcycle operator
6	3/1/2004, 1821 hrs	Pittsylvania County, Primary Highway	Driver/27/M	BF injuries to chest	Legal	**M/C** ran off road and struck median; Excessive speed - motorcycle operator
7	3/14/2004, 1500 hrs	Rappahannock County, Primary Highway	Driver/22/M	Cervical fracture	Legal	**M/C** ran off road and struck guard rail; Reckless driving - motorcycle operator
8	3/28/2004, 1340 hrs	Hanover County Urban Street	Driver/47/M	Chest trauma- closed	Legal	**M/C** ran off road and rolled over; Reckless driving - motorcycle operator
9	4/3/2004, 1115 hrs	Louisa County, Primary Intersection	Driver/51/M	BFT to head	Legal	Vehicle turned into path of M/C; Reckless driving - vehicle driver
10	4/18/2004, 0218 hrs	City of Portsmouth, Interstate	Driver/41/M	Closed head injury	Not Answered	**M/C** lost control and struck concrete wall; Reckless driving - motorcycle operator
11	4/21/2004, 1605 hrs	Farifax County, Urban Street	Driver/26/M	Head injury	Incomplete Data	**M/C** ran off the road and struck guard rail; Reckless driving and alcohol use - motorcycle operator
12	4/23/2004, 1855 hrs	Madison County, Secondary Highway	Driver/31/M	BFT to head and neck	Legal	**M/C** ran off road and struck tree; Reckless driving - motorcycle operator
13	5/6/2004, 1500 hrs	Luneburg County, Secondary Highway	Driver/29/M	Massive brain trauma	Legal	**M/C** ran off road and struck tree; Fail to maintain control - motorcycle operator
14	5/7/2004, 0330 hrs	Patrick County. Secondary Highway	Driver/48/M	Chest and abdominal injuries	Legal	**M/C** ran off road and struck mailbox and culvert; Fail to maintain control - motorcycle operator
15	5/8/2004, 1915 hrs	Wise County, Primary Highway	Driver/67/M	Multiple body injuries	Legal	**M/C** ran off the road and over embankment; Failure to maintain control - motorcycle operator
16	5/8/2004, 1945 hrs	Stafford County, Secondary Highway	Driver/48/M	Multiple severe Injuries to the head and torso	**No Helmet**	**M/C** ran off road and over turned; DUI - motorcycle operator
17	5/14/2004, 1915 hrs	City of Norfolk, Urban Street	Driver/43/M	Multiple trauma to head and body	**No Helmet**	Vehicle turned left into path of M/C; Failure to yield - vehicle driver
18	5/15/2004, 2140 hrs	Charles City County, Secondary Intersection	Driver/21/M	BF injury to chest	Legal/Full face with visor	**M/C** eluding police, ran off road and struck embankment; Reckless driving - motorcycle operator
19	5/30/2004, 1440 hrs	Rappahannock County, Primary Highway	Driver/42/M	Severe head injuries	Legal	**M/C** crossed centerlines and struck vehicle head-on; Reckless driving - motorcycle operator
20	5/30/2004, 1930 hrs	Greene County, Secondary Highway	Passenger/47/F	BFT to head	Novelty	**M/C** ran off road and overturned; Reckless driving - motorcyle operator
21	6/12/2004, 2030 hrs	Clarke County, Primary Intersection	Driver/43/M	BFT to head neck and extremities	Novelty	**M/C** ran off road and struck guard rail; Reckless driving and alcohol use - motorcycle operator
22	6/14/2004, 2048	City of Hampton, Urban Street	Driver/39/M	Blunt chest trauma	Legal	Vehicle lost control and struck M/C; Reckless driving - vehicle driver
23	6/16/04, 1530 hrs	Orange County, Secondary Highway	Driver/23/M	Closed head injuries	Incomplete Data	**M/C** ran off the road and struck tree; Reckless driving - motorcycle operator
24	6/19/2004, 1503 hrs	Chesterfield County, Urban Intersection	Driver/17/M	BFT to head, chest and abdomen	Legal	**M/C** struck slowing vehicle in rear; Reckless driving - motorcycle operator
25	6/27/2004, 1533 hrs	Clarke County, Secondary Highway	Driver/41/M	Multiple systematic BFT to head and body	Legal	Vehicle crossed centerlines and struck M/C head-on; Reckless driving and drug use- vehicle driver

TABLE 2
Virginia Motorcycle Traffic Fatalities - 2004 (51 total)

	Date/Time	Crash Location	Position/Age/Sex	Cause of death	Helmet Use/Comments	Crash Circumstances/At Fault Driver
26	6/29/2004, 1044 hrs	City of Hampton, Urban Street	Driver/25/F	Cervical cord transection	Legal/ Improper fit (too big) and came off	**M/C** ran off road and struck tree; Reckless driving and alcohol use - motorcycle driver
27	7/3/2004, 1940 hrs	City of Norfolk, Urban Street	Driver/29/M	Massive closed head trauma	Incomplete Data	**M/C** ran off road and struck curb; Reckless driving - motorcycle operator
28	7/6/2004, 1750 hrs	Carroll County, Secondary Highway	Driver/43/M	Trauma to head and spine	Legal	**M/C** ran off road and struck embankment; Reckless driving - motorcycle operator
29	7/14/2004, 1019 hrs	Loudon County, Urban intersection	Driver/21/M	Dissection of great vessels, head and multiple body trauma	Legal	**M/C** ran off road and struck shoulder; Defective front tire - motorcycle operator
30	7/16/2004, 1955 hrs	City of Newport News, Urban Intersection	Driver/34/M	Blunt trauma to head and chest	Incomplete Data	Vehicle rearended M/C ; Defective equipment - vehicle driver
31	7/24/2004, 1442 hrs	Frederick County, Secondary Highway	Driver/32/M	BFT to head	Incomplete Data	Vehicle backed out into roadway and struck M/C, Improper backing - vehicle driver
32	7/30/2004, 1405 hrs	Rockbridge County, Secondary Highway	Driver/30/M	Chest trauma	Legal/Helmet was full face and buckled, the helmet was knocked off of the driver	**M/C** ran off road and struck embankment; Fail to maintain control - motorcycle operator
33	7/30/2004, 1450 hrs	Madison County, Primary Highway	Driver/57/M	Closed head injury	Legal	**M/C** ran off road and over embankment; Reckless driving - motorcycle operator
34	7/31/2004, 1600 hrs	Rockingham County, Primary Highway	Driver/40/M	Massive head trauma	Novelty	**M/C** ran into side of vehicle; Reckless driving and alcohol use - motorcycle operator
35	8/3/2004, 1610 hrs	Arlington County, Primary Highway	Driver/27/F	Multiple head and body trauma	Legal	**M/C** rearended vehicle; Reckles driving - motorcycle operator
36	8/11/2004, 0938 hrs	City of Suffolk, Urban Street	Driver/24/M	Blunt trauma and neck fracture	Legal/Full Face Shield	Vehicle crossed centerlines and struck M/C head-on, Reckless driving - vehicle driver
37	8/14/2004, 2340 hrs	Rockbridge County, Primary Highway	Driver/42/M	Neck fracture	Legal	**M/C** ran off road and struck guard rail; Reckless driving - motorcycle operator
38	8/26/2004, 0145 hrs	Culpeper County, Primary Highway	Driver/35/M	BFT to neck and pelvis	Novelty	**M/C** ran off the road and struck embankment; Reckless driving and alcohol use - motorcycle operator
39	8/27/2004, 0020 hrs	Montgomery County, Interstate	Driver/52/M	Massive body trauma	Incomplete Data	**M/C** ran off road and struck guard rail; Reckless driving - motorcycle operator
40	8/28/2004	Amelia County, Secondary Highway	Driver/42/M	BFT to head and chest	**No Helmet**	**M/C** ran off road and struck tree; Reckless driving - motorcycle operator
41	8/31/2004, 0903 hrs	Stafford County, Secondary Highway	Driver/53/M	Multiple body injuries	Legal	**M/C** slid under vehicle; Reckless driving and failure to maintain control - motorcycle operator
42	9/3/2004, 0610 hrs	Franklin County, Primary/Secondary Intersection	Driver/57/M	Closed head and injury	Novelty/ with plastic clasp. Had a warning Label on inside. Helmet came off in crash.	**M/C** ran off the road and struck embankment; Reckless driving - motorcycle operator
43	9/4/2004, 1715 hrs	Amherst County, Secondary Intersection	Passenger/59/F	Skull fracture	Legal	Vehicle turned left in front of M/C; Reckless driving - vehicle driver
44	9/17/2004, 2200 hrs	City of Hampton, Interstate	Passenger/42/F	Multiple trauma to head and body	Legal	Vehicle rearended M/C ; DUI and excessive speed - vehicle driver
45	9/26/04, 1600 hrs	City of Suffolk, Urban Intersection	Driver/46/M	BFT to head and body	Legal/Helmet came off in crash, strap intact.	Vehicle struck M/C head-on; Fail to maintain control - vehicle operator
46	10/1/2004, 1946 hrs	City of Hampton, Interstate	Driver/57/M	Blunt chest injury	Legal	**M/C** crossed centerlines and struck vehicle head-on; Reckless driving - motorcycle operator
47	10/17/2004, 1955 hrs	City of Newport News, Interstate	Driver/33/M	***NO INFO YET< TOO NEW***	Legal	**M/C** ran red light and struck vehicle in angle collision; Reckless driving - motorcycle driver
48	10/26/2004, 1655 hrs	Loudon County, Primary Highway	Passenger/38/F	***NEW ONE***	Legal	**M/C** struck vehicle turning in front of it; Speeding - motorcycle operator
49	10/31/2004, 1150 hrs	Page County, Secondary Highway	Driver/48/M	***NO INFO YET< TOO NEW***	Incomplete Data	**M/C** ran off road and struck embankment; Reckless driving - motorcycle operator
50	11/7/2004, 1100 hrs	City of Virginia Beach, Urban Street	Driver/37/M	Blunt chest injury	Legal/Full face	Vehicle turned left into path of M/C; Failure to obey signs - vehicle driver
51	11/13/2004	Pittsylvania County, Primary/Secondary Intersection	Driver/34/M	Massive head injuries	**No Helmet**	**M/C** ran off road and struck curb; Reckless driving and high speed - motorcycle operator
	BF= Blunt Force	**BFT= Blunt Force Trauma**				

TABLE 3

Virginia Motorcycle Traffic Fatalities – 1985 through 2004

Year	# of Deaths	Year	# of Deaths
2004	51	1994	29
2003	54	1993	31
2002	54	1992	40
2001	44	1991	40
2000	45	1990	57
1999	38	1989	33
1998	41	1988	65
1997	38	1987	60
1996	35	1986	85
1995	34	1985	96

Total Virginia Reported Deaths = 970 (Average per year = 49)

Source: Department of Motor Vehicles, Virginia Traffic Crash Facts (1985-2004)

TABLE 4

NHTSA Helmet Law Repeal Studies - 4 States

Observed Helmet use by State		During Universal Law		After Law Repealed		Fatality increase
Arkansas		97%		52%		+21%
Texas		97%		66%		+31%
Kentucky		96%		56%		+50%
Louisiana		100%		52%		+100%

Sources:
NHTSA, Evaluation of Motorcycle Helmet Law Repeal (Arkansas & Texas, September 2000)
NHTSA, Evaluation of Motorcycle Helmet Law Repeal (Kentucky & Louisiana, October 2003)